combination of normalizing and tempering, inhibition of type 4 creep damage cannot be effected.

By contrast, the present invention distinctly provides the following:

> **A method of manufacturing** a long-life heat-resisting low alloy steel **welded component** including the steps of
>
> subjecting a base metal containing, at % by weight, C: 0.15% or less, Si: 0.5% or less, Mn: 0.3 to 0.8%, Cr: 1.9 to 2.6%, Mo: 0.87 to 1.20%, and a balance of iron and unavoidable impurities,
>
> to a **hot working,**
>
> to a **heat treatment**, and
>
> then to a **welding,**
>
> wherein the base metal is **normalized once or more times before the welding in addition to the hot working.**

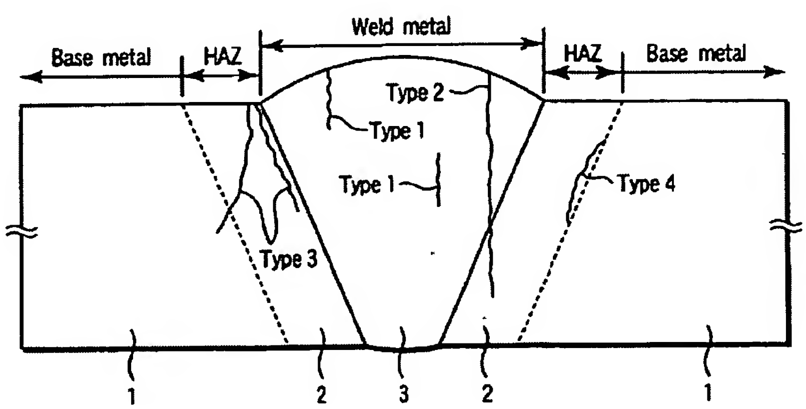
(See, e.g., present claim 1; see also present claim 14, which recites a welded component manufactured by the above-mentioned method steps).

The present invention proposes a solution to the drawbacks of conventional techniques of manufacturing steel welded components, in which an object thereof is to provide a long-life heat-resisting low alloy steel welded component that does not easily cause a creep damage in a heat-affected zone and a method of manufacturing the same. In particular, based on the findings described in the present specification at page 7, line 17 through page 10, line 12, the present invention reduces the amount of coarse carbides, which cause to damages of type 4, remaining in former austenite (γ) grain boundaries of a *welded* component. Accordingly, the creep lifetime of the weld zone of the heat-resisting steel is significantly improved. More specifically, before the base metal is welded, it is subjected to normalizing once or more times, thereby reducing the amount of coarse carbides. (See present specification at page 10, lines 13-22).

Applicant notes, as a general matter, the following from the present specification regarding types of creep damage, the significance of type 4 creep damage, and the need for its prevention in welded components:

> In welding of a steam pipe, a weld with a high joint efficiency is used. When such a steam pipe is used continuously under a high temperature and high pressure for a long period of time, various creep damages are created at the weld zone. There are four types of the creep damages as shown in FIG. 1. More specifically, there are a damage of type 1 created in a weld metal (deposit) 3, a damage of type 2 created in a section from a weld metal 3 to a heat-affected zone (HAZ) 2, a damage of type 3 created from a weld metal side of the HAZ 2, and a damage of type 4 created in a base metal 1 side of the HAZ 2. <u>In particular, of these, the type 4 damage, which is created in a fine grained region of the HAZ, causes to significantly shorten the lifetime of the weld zone of the pipe, and therefore this type of damage is perceived as a problem in many countries</u>.

(Page 2, line 22 through page 3, line 11). Figure 1 of the present invention is reproduced below for the Examiner's convenience.



Applicant also notes that additional background information on the types of creep damage are shown and discussed in the article "Review of Type IV Cracking" by F. V. Ellis and R. Viswanathan (ASME PVP vol. 380, July 1998). A copy of the article was previously filed with the present application.

Evidence of the effect of the present invention, which is commensurate with the present invention, is provided in a non-limiting demonstration of the present invention in

Applicant's symposium article at the "43rd Symposium on Strength of Materials at High Temperatures" hosted by "The Society of Materials Science, Japan" on December 8, 2005 (Hideshi Tezuka, Proceedings of the 43rd Symposium on Strength of Materials at High Temperatures, Dec. 8-9, Fukui (2005), pp. 72-76). The article is entitled "Creep damages of fine grained heat affected zone of welded 2.25%-1%Mo steel with plural times of normalizing before welding" by Hideshi Tezuka. A copy is provided herewith for the Examiner's convenience.

Applicant notes that in the article, the "Introduction" section corresponds to the "Background of Invention" and the descriptions in the present specification at page 7, line 17 to page 10, line 22. Applicant directs the Examiner's attention to the following in the article:

FIG. 6 shows results of observations of macro-structure of specimens after creep rupture tests carried out under a condition of 873K x 54MPa.

FIG. 7 shows results of observations of the microstructure thereof. In a plural-time normalizing/low-impurity steel, significant elongation is observed. In the same sample, grains are greatly deformed as shown in FIG. 7(d), and occurrence of type IV (type 4) damage is not observed. On the other hand, in the specimens produced by conventional process, occurrence of the type IV damage was observed irrespective of the impurity level. In addition, all of large weld joint specimens produced by the conventional process were ruptured during creep tests carried out under the other conditions.

FIG. 8 shows results of TEM observation of precipitate on replica films extracted in the vicinities of the ruptured position of specimens after the creep rupture tests carried out under a condition of 873K x 54MPa. No significant difference was found, but the same significant agglomeration of carbides as that found at a damaged portion of the actual component is observed in the conventional-process/high-impurity steel. On the other hand, no significant agglomeration is observed in the plural-time normalizing steel.

Further, in the "Conclusion" section of the article, Applicant notes the following findings:

(1) The type IV creep damage was not generated and the creep rupture strength was improved markedly by the plurality of normalizing for a low impurity steel.

(2) An agglomeration region of carbides was not created in the steel which subjected to a plurality of normalizing.

(3) For a high impurity steel, the type IV creep damage was generated although a plurality of normalizing was performed for the steel There were no market differences in the creep rupture strength between the particular steel and a conventional steel.

(4) These results suggest that it is possible to suppress the type IV creep damage effectively by a plurality of normalizing for a low impurity steel.

Applicant further notes that the effect of the present invention is shown in the Examples of the present specification. Accordingly, Applicant directs the Examiner's attention to the Examples and Comparative Example at pages 35-40 of the present specification. The results are shown in Table 2, at page 41 of the present specification, reproduced below for the Examiner's convenience.

TABLE 2

	Aging conditions		Evaluation results	
	Temperature (° C.)	Time (hours)	High-density agglomerated carbides	Type 4 damage
Example 1	680	About 220	—	Not present
Example 2	670	About 380	—	Not present
Example 3	650	About 1,100	Few	Present
Reference Example	566	10,000	Few	Not present
Comparative Example 1	—	—	Great deal	Present

Applicants note that the steel types for the Examples are commensurate with the claimed invention.

As recited on pages 42-45 of the present specification,

> [As demonstrated by Table 2], in **Examples 1 and 2**, no type 4 damage was observed until they ruptured, i.e. they underwent an aging of even severer conditions than those actual use. The aging time of each of Examples 1 and 2, when converted into the actual use conditions, is about 240,000 hours. Thus, it was confirmed that the welded component of the present invention can fully withstand the long term use as a main steam pipe of a thermal power plant.
>
> By contrast, a type 4 damage was observed in **Comparative Example 1**. It was confirmed by an observation under TEM that a great amount of high-density agglomerated carbides were created in the HAZ fine grained region of Comparative Example 1.
>
> In **Example 3**, a type 4 damage was observed; however, the rupture of the test piece was not directly caused by the type 4 damage. It is understood that the type 4 damage can be suppressed significantly in Example 3, thereby the rupture occurred in the portion other than the HAZ fine grained region. This is because, as compared to Comparative Example 1, the amount of high-density agglomerated carbides was remarkably less in Example 3.
>
> Further, in the case of the **reference example**, the base metal was normalized once as a separate step from the hot working before the welding as in the present invention. In this example, the type 4 damage was not observed even though it was aged at substantially an equal temperature and load to the actual use conditions.

Therefore, in light of the evidence of record, the EP '026 reference's lack of a disclosure of the elements of the manufacturing method or welded component of the claimed invention, and a suggestion of the effect of the claimed invention, the claimed invention is novel and unobvious over the reference.

Accordingly, withdrawal of the rejection is requested.

Applicant submits that the application is now in condition for allowance. Early notification of such allowance is earnestly solicited.

Should the Examiner deem that any further action is necessary to place this application in even better form for allowance, the Examiner is encouraged to contact Applicant's undersigned representative at the below listed telephone number.

Respectfully submitted,

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